PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2001-269790**

(43)Date of publication of application : **02.10.2001**

(51)Int.Cl. **B23K 26/06**

B23K 26/00

H05K 3/00

(21)Application number : **2000-086109**

(22)Date of filing : **27.03.2000**

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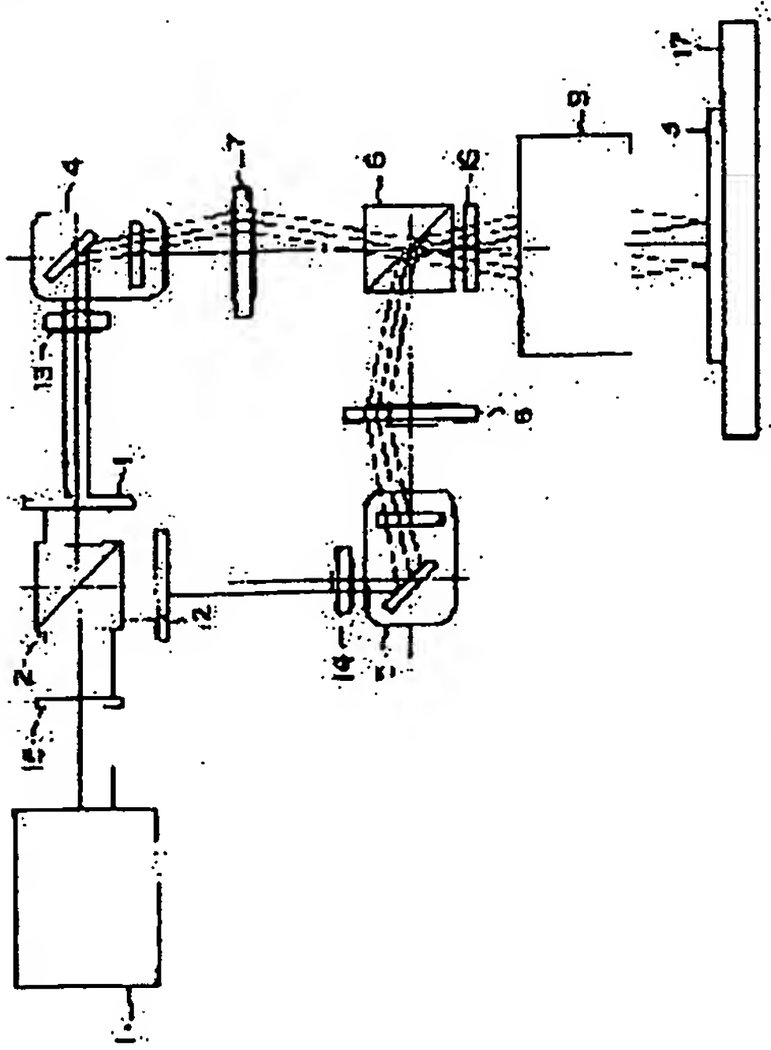
(54) LASER BEAM MACHINING METHOD AND DEVICE



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a laser beam machining device capable of increasing machining speed and eliminating as much as possible positional restrictions of an optical system.

SOLUTION: The device includes a polarizing beam splitter 2 for spectrally dispersing a laser beam from a laser generator 1 into first and second polarizing components, a galvano-scanner 4 for oscillating the first polarizing component to biaxial direction so that it is emitted to a desired position on a workpiece 3, a galvano-scanner 5 for oscillating the second polarizing component to biaxial direction so that it is emitted to a prescribed position on the workpiece, a collimator lens 7 for projecting the first polarizing component as a virtual image in a polarizing beam splitter 6, and a collimator lens 8 for projecting the second polarizing component as a virtual image in the polarizing beam splitter 6. The polarizing beam splitter 6 superimpose the first and second polarizing components from the collimator lenses 7, 8 so that they are in a common optical path, and emits two kinds of laser beams. An fθ lens

9 emits the two kinds of laser beams from the polarizing beam splitter 6 to the workpiece.

LEGAL STATUS

[Date of request for examination]	19.06.2001
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3479878
[Date of registration]	10.10.2003
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

[Claim(s)]

[Claim 1] The laser beam from a laser oscillation machine is divided into the 1st polarization component and the 2nd polarization component by the 1st polarization beam splitter. Lead said 1st polarization component to the 1st GARUBANO scanner, and said 2nd polarization component is led to the 2nd GARUBANO scanner. The laser beam from said 1st GARUBANO scanner and said 2nd GARUBANO scanner, respectively As it introduces into the 2nd polarization beam splitter and is on a common optical path, two kinds of laser beams Superposition, The laser-beam-machining approach characterized by irradiating two kinds of laser beams from this 2nd polarization beam splitter in the location where workpieces-ed differ through ftheta lens, respectively, and performing coincidence processing.

[Claim 2] In the laser-beam-machining approach according to claim 1 Between said 1st GARUBANO scanner and said 2nd polarization beam splitter, The 1st and 2nd collimate lens is arranged between said 2nd GARUBANO scanner and said 2nd polarization beam splitter, respectively. The laser-beam-machining approach characterized by for the laser beam from the said 1st and 2nd GARUBANO scanner having formed the virtual image inside said 2nd polarization beam splitter, and having arranged the said 1st and 2nd GARUBANO scanner in the entrance pupil location of said ftheta lens, respectively.

[Claim 3] The laser-beam-machining approach characterized by having arranged the said 1st and 2nd GARUBANO scanner in the entrance pupil location of said ftheta lens, respectively in the laser-beam-machining approach according to claim 1.

[Claim 4] In the laser-beam-machining approach according to claim 1 Between said 1st GARUBANO scanner and said 2nd polarization beam splitter, The 1st and 2nd collimate

lens is arranged between said 2nd GARUBANO scanner and said 2nd polarization beam splitter, respectively. The laser beam from this 1st and 2nd collimate lens is always made to carry out incidence to said 2nd polarization beam splitter at a fixed include angle, respectively. The laser-beam-machining approach characterized by arranging a lens between said 2nd polarization beam splitter and said ftheta lens, and the laser beam from the said 1st and 2nd GARUBANO scanner forming a virtual image in it in the entrance pupil location of said ftheta lens.

[Claim 5] A laser oscillation machine and the 1st polarization beam splitter which divides the laser beam from this laser oscillation machine into the 1st polarization component and the 2nd polarization component, The 1st GARUBANO scanner for making at least 1 shaft orientations shake so that the location of the request of said 1st polarization component on a workpiece-ed may be irradiated, The 2nd GARUBANO scanner for making at least 1 shaft orientations shake so that said 2nd polarization component may be irradiated at the position on said workpiece-ed, Said 2nd polarization beam splitter for piling up said 1st [the], said 1st [the] from the 2nd GARUBANO scanner, and the 2nd polarization component, as it is on a common optical path, and carrying out outgoing radiation of two kinds of laser beams, Laser-beam-machining equipment characterized by including ftheta lens for irradiating two kinds of laser beams from this 2nd polarization beam splitter at said workpiece-ed.

[Claim 6] It is laser-beam-machining equipment characterized by being the thing at which 2 shaft orientations shaft orientations and the said 1st and 2nd GARUBANO scanner cross at right angles the said 1st and 2nd polarization component mutually in laser-beam-machining equipment according to claim 5, respectively are made to shake.

[Claim 7] Laser-beam-machining equipment characterized by arranging the 1st and 2nd mask for specifying the cross-section configuration of a laser beam to the outgoing radiation side of the said 1st [in said 1st polarization beam splitter], and 2nd polarization component, respectively in claim 5 or laser-beam-machining equipment given in six.

[Claim 8] Laser-beam-machining equipment characterized by arranging the 1st and 2nd optical means for changing the linearly polarized light into the outgoing radiation side of said 2nd polarization beam splitter the incidence side of said 1st polarization beam splitter at the circular polarization of light, respectively in laser-beam-machining equipment according to claim 5 to 6.

[Claim 9] The 1st collimate lens for making said 1st polarization component from said 1st GARUBANO scanner project as a virtual image into said 2nd polarization beam splitter in laser-beam-machining equipment according to claim 8, It has further the 2nd collimate lens for making said 2nd polarization component from said 2nd GARUBANO scanner project as a virtual image into said 2nd polarization beam splitter. Said 1st [the], laser-beam-machining equipment characterized by having arranged the 2nd GARUBANO scanner in the entrance pupil location of said ftheta lens, respectively.

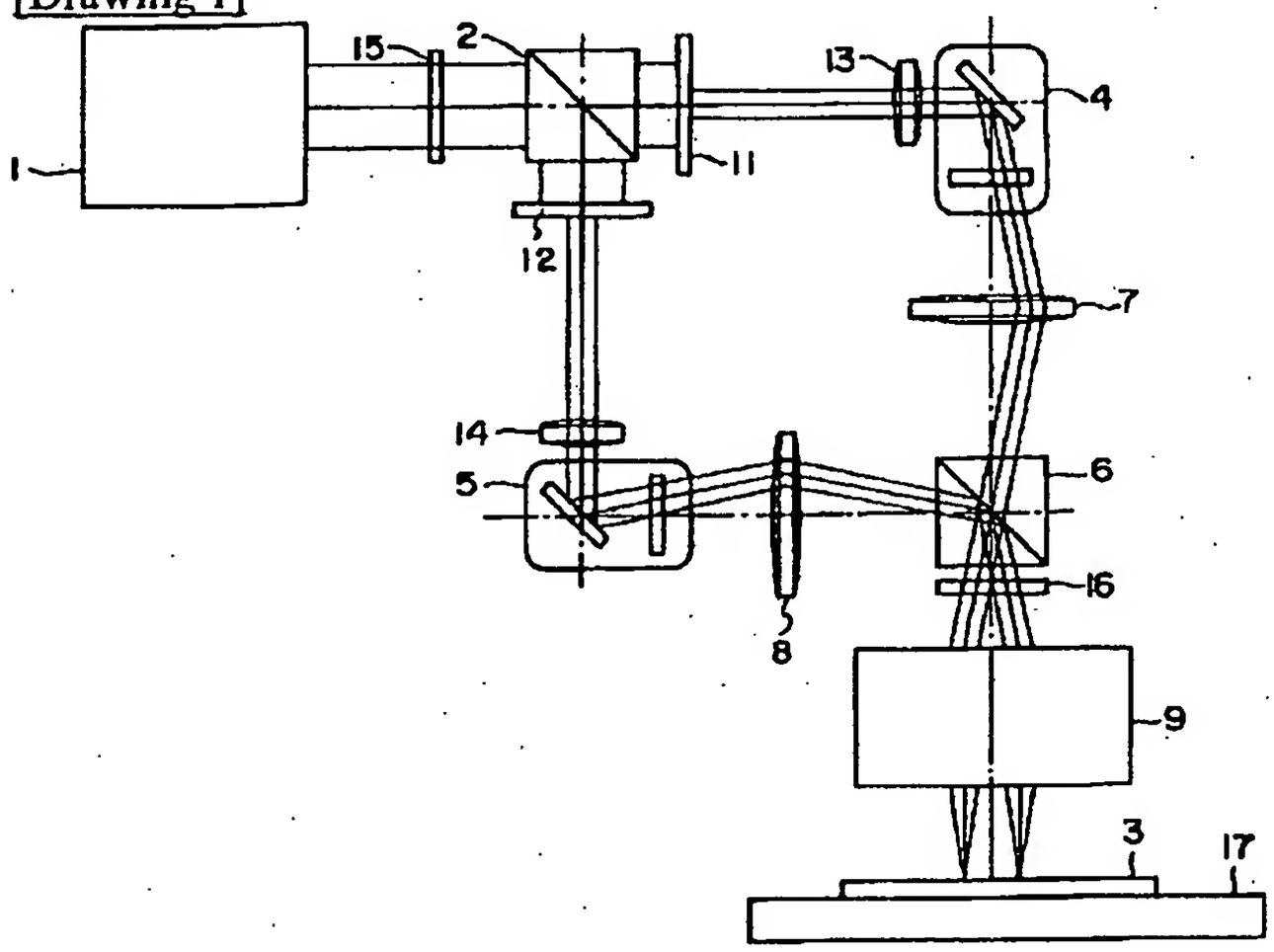
[Claim 10] Laser-beam-machining equipment characterized by having arranged the said 1st and 2nd GARUBANO scanner in the entrance pupil location of said ftheta lens, respectively in laser-beam-machining equipment according to claim 8.

[Claim 11] In laser-beam-machining equipment according to claim 8 Between said 1st GARUBANO scanner and said 2nd polarization beam splitter, The 1st and 2nd collimate lens is arranged between said 2nd GARUBANO scanner and said 2nd polarization beam splitter, respectively. The laser beam from this 1st and 2nd collimate lens is always made

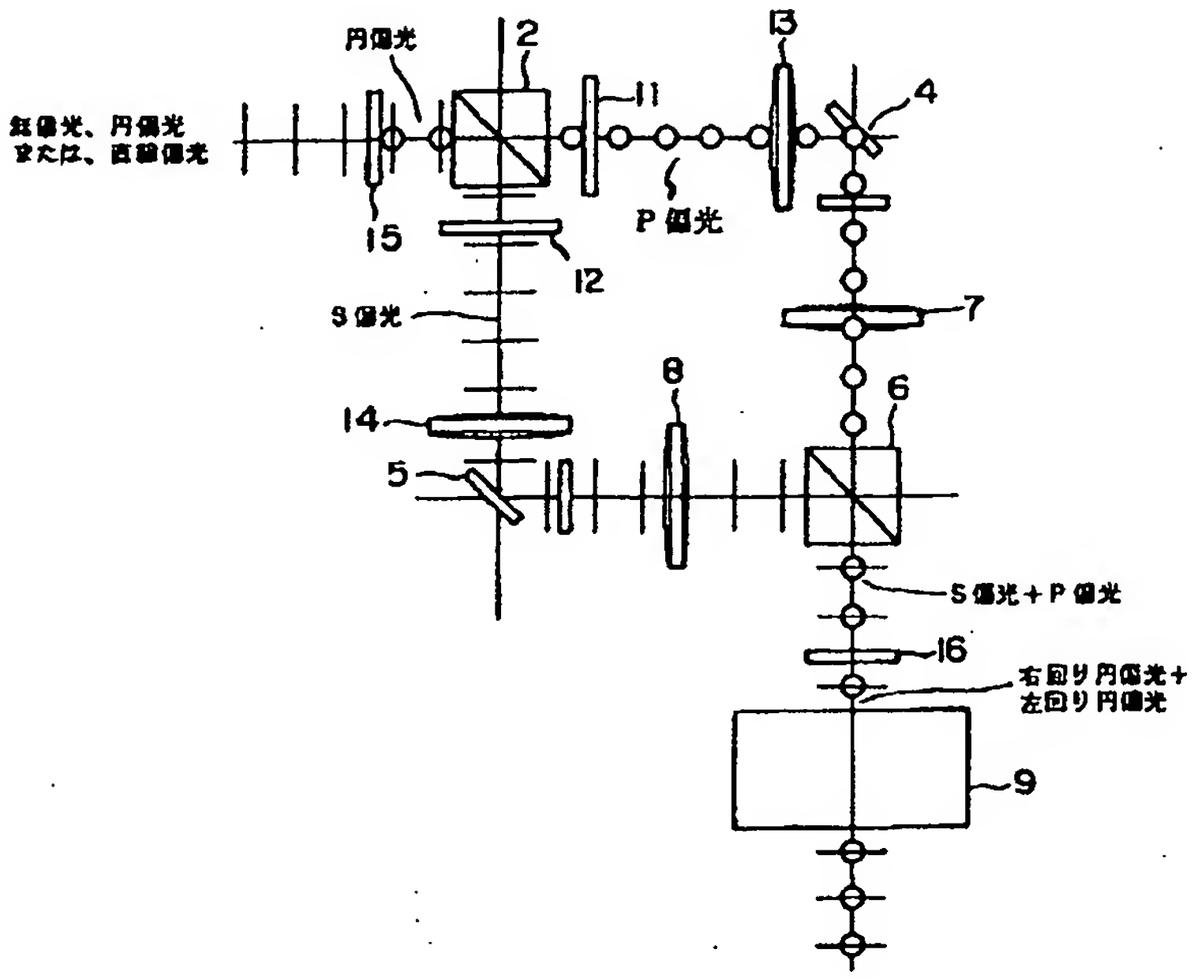
to carry out incidence to said 2nd polarization beam splitter at a fixed include angle, respectively. Laser-beam-machining equipment characterized by arranging a lens between said 2nd polarization beam splitter and said ftheta lens, and the laser beam from the said 1st and 2nd GARUBANO scanner forming a virtual image in it in the entrance pupil location of said ftheta lens.

[Claim 12] Laser-beam-machining equipment characterized by arranging the 3rd collimate lens at the incidence side of said 1st GARUBANO scanner, and arranging the 4th collimate lens at the incidence side of said 2nd GARUBANO scanner in laser-beam-machining equipment according to claim 9 to 11.

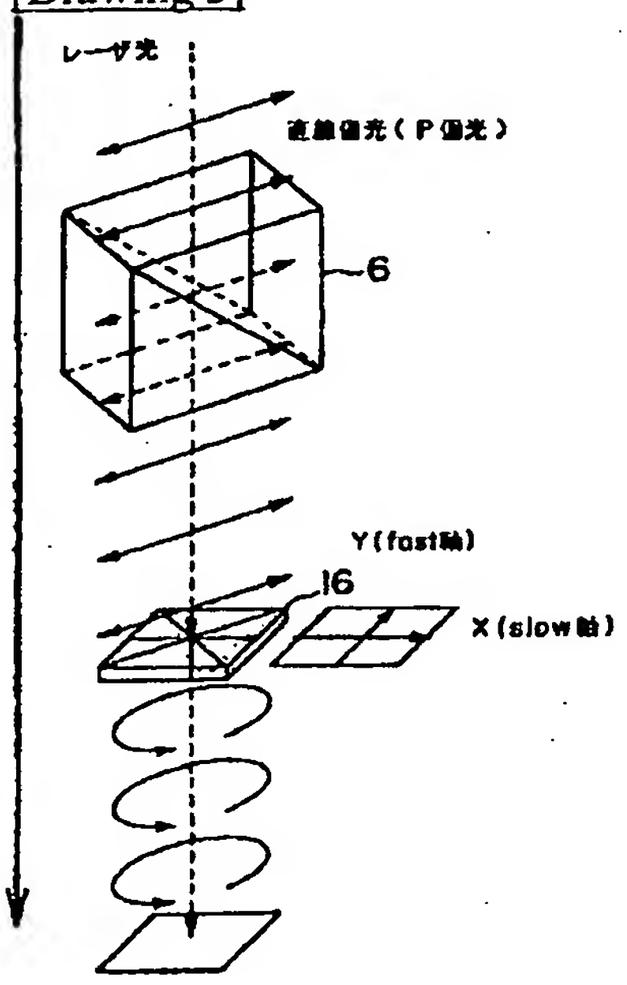
[Drawing 1]



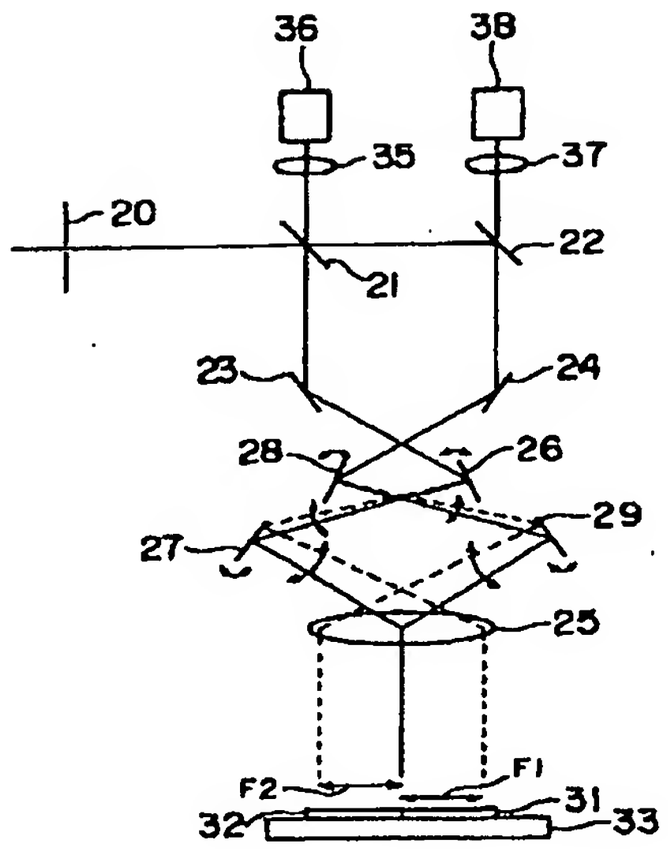
[Drawing 2]



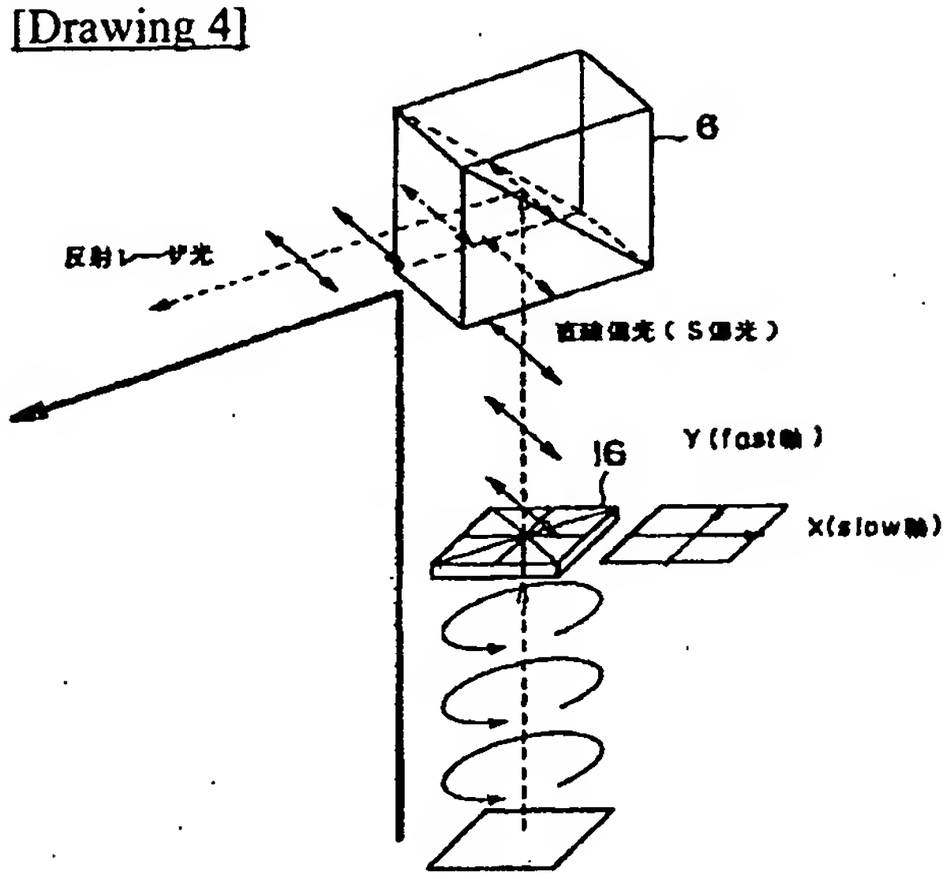
[Drawing 3]



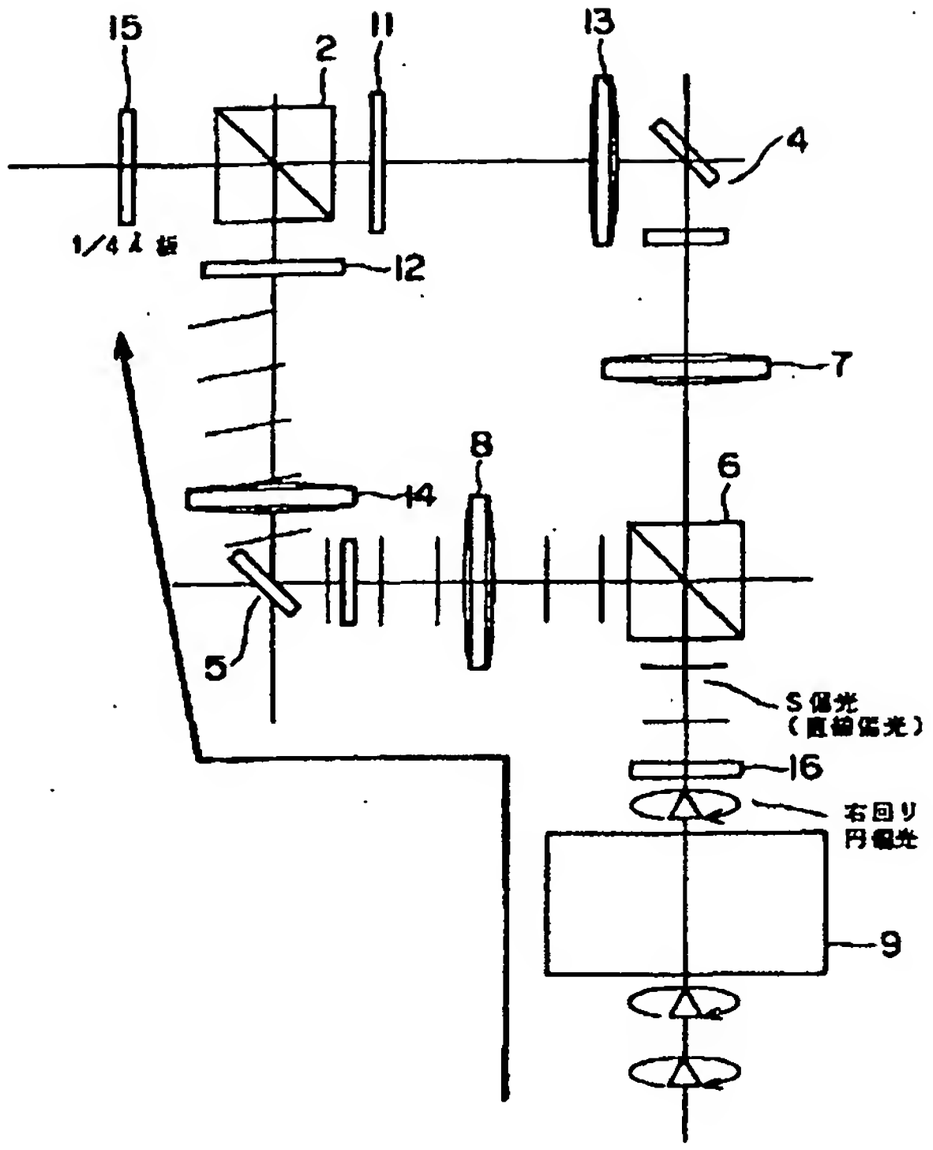
[Drawing 8]



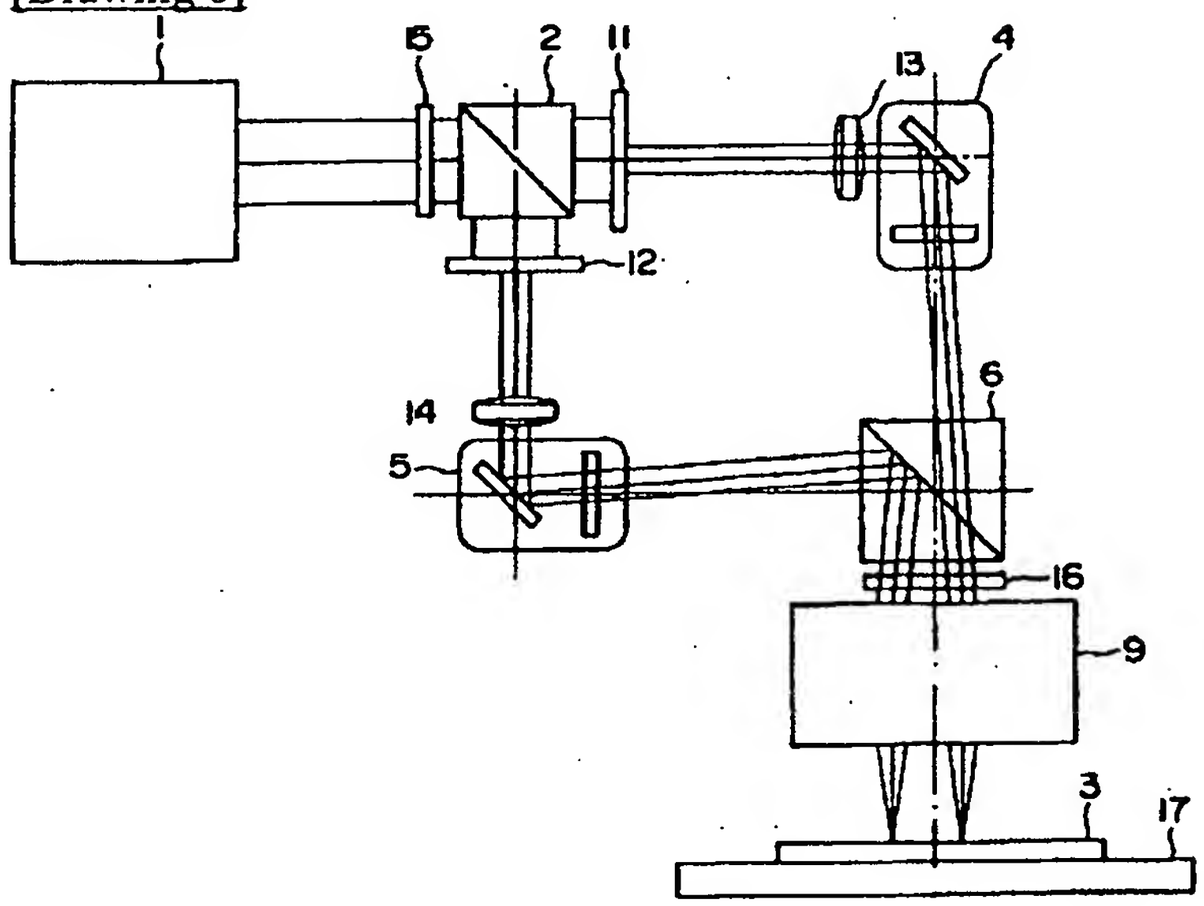
[Drawing 4]



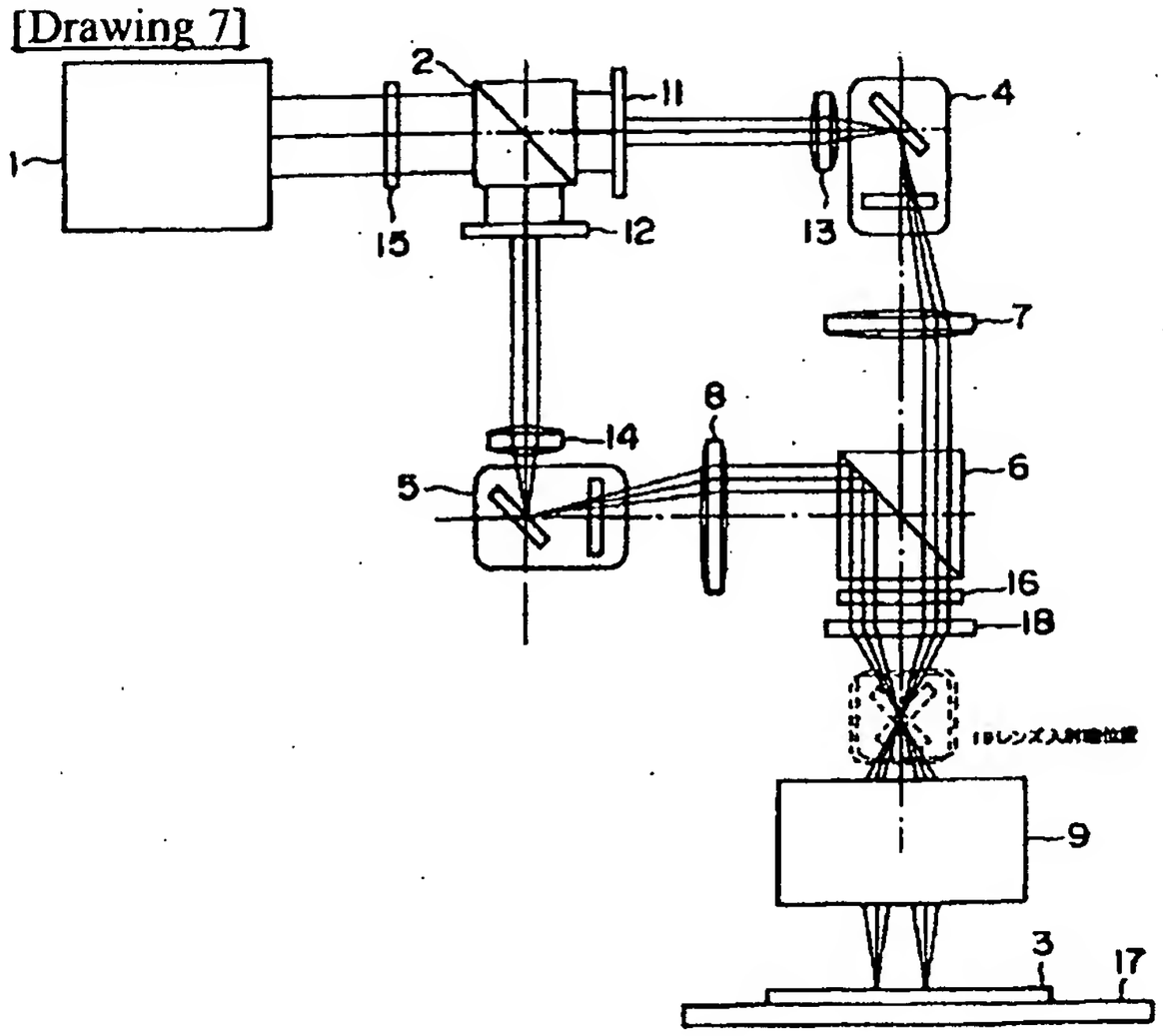
[Drawing 5]


15
2
11
13
4
1/4 λ 板
12
7
8
6
14
5
S偏光
(直線偏光)
16
右回り
円偏光
9

[Drawing 6]


15
2
11
13
4
12
14
6
5
16
9
3
17

[Drawing 7]



[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the laser-beam-machining approach and processing equipment, especially this invention makes punching processing a key objective, and relates to the laser-beam-machining approach and processing equipment which were improved so that the working speed could be raised.

[0002]

[Description of the Prior Art] As for the laser-beam-machining equipment which made punching processing the key objective, what was equipped with the so-called X-Y stage in which horizontal migration is possible to X shaft orientations and Y shaft orientations for the stage in which a work piece is carried is common. This laser-beam-machining equipment changes the exposure location of a pulse-like laser beam by moving a work piece by the X-Y stage. For this reason, positioning by the X-Y stage takes time amount, and working speed has a limit. For convenience, this laser-beam-machining equipment is called the 1st method.

[0003] On the other hand, the laser-beam-machining equipment which aimed at improvement in working speed by making a laser beam shake using a GARUBANO scanner is offered. If it explains briefly, after letting the mask for specifying the cross-section configuration for the laser beam outputted from the laser oscillation machine pass, it will lead to a X-Y GARUBANO scanner. A X-Y GARUBANO scanner consists of the X-axis galvanomirror for making X shaft orientations shake the laser beam which carried out incidence on the work piece arranged to the processing field, and the Y-axis galvanomirror for making Y shaft orientations shake as known well. With such an X-Y GARUBANO scanner, a laser beam is shaken so that it may cross throughout the predetermined field set up on the work piece through ftheta lens. In addition, the work piece is carried in the X-Y stage movable to X shaft orientations and Y shaft orientations. For convenience, this laser-beam-machining equipment is called the 2nd method.

[0004] By this 2nd method, after processing it by making a laser beam shake to the predetermined field on a work piece, the following work piece is arranged to a processing field by the X-Y stage. According to such 2nd method, although improvement in working speed can be aimed at with the combination of a X-Y GARUBANO scanner and an X-Y stage, processing area has constraint. Although what is necessary is just to enlarge the path of ftheta lens for making processing area large, since ftheta lens of the diameter of macrostomia is an expensive rank, the problem on cost arises.
[0005] On the other hand, this invention person proposed the laser-beam-machining equipment which can cancel the trouble of the 2nd method of the above (JP,8-141769,A). This is explained with reference to drawing 8 .
[0006] In drawing 8 , a mask 20 is branched by through and the half mirror 21 in the laser beam of the shape of a pulse from the laser oscillation machine which is not illustrated. The transmitted light of a half mirror 21 is led to a dichroic mirror 22. The reflected light of a half mirror 21 and a dichroic mirror 22 is led to the mirrors 23 and 24 arranged at those lower parts, respectively.
[0007] In this processing equipment, the reflected light of a mirror 23 is introduced into the field of the one half of the ftheta lens 25 through the 1st and 2nd galvanomirror 26 and 27 which constitutes the 1st X-Y GARUBANO scanner. He is trying to, introduce the reflected light of a mirror 24 into the field of the remaining one half of the ftheta lens 25 on the other hand through the 3rd and 4th galvanomirror 28 and 29 which constitutes the 2nd X-Y GARUBANO scanner. In order to do in this way, the 1st and 3rd galvanomirror 26 and 28 is arranged to the symmetry about a medial axis at the incidence side of the ftheta lens 25, and the 2nd and 4th galvanomirror 27 and 29 should just consider it as symmetry arrangement similarly.
[0008] The 1st and 2nd field F1 and F2 carried out 2 ****s is set to the directly under field of the ftheta lens 25, and work pieces 31 and 32 are arranged in each field. These work pieces 31 and 32 are processed into coincidence. Of course, the work piece of the magnitude corresponding to the 1st and 2nd field F1 and F2 may be arranged, and one work piece may be processed into coincidence by one half. Work pieces 31 and 32 are laid on X-Y stage 33.
[0009] Above the half mirror 21 and the dichroic mirror 22, the 2nd alignment system by the 1st alignment system and the 2nd lens 37 by the 1st lens 35 and 1st CCD camera 36, and 2nd CCD camera 38 is arranged, respectively.
[0010] Drive control of the combination of the 1st and 2nd galvanomirror 26 and 27 and the 3rd and 4th galvanomirror 28 and 29 is carried out so that it may become the same motion with the control unit which is not illustrated. X-Y stage 33 is also driven in order to move a work piece after termination of laser beam machining with a control unit, and it carries out horizontal migration to X shaft orientations and Y shaft orientations.
[0011] The processing location to work pieces 31 and 32 is decided by the command value of angle of rotation given to each galvanomirror from a control device, and does not remain in the hole arranged regularly, but the hole of an irregular array and a marking still like an alphabetic character and a notation are also possible for it.
[0012]
[Problem(s) to be Solved by the Invention] The laser-beam-machining equipment by the above-mentioned proposal has the location-constraint which says that it is a symmetric position mutually, and it must collect into a compact and the 1st and 3rd galvanomirror

26 and 28 and the 2nd and 3rd galvanomirror 27 and 29 must moreover arrange above the ftheta lens 25, although working speed becomes twice [at least] compared with the 2nd method. As for especially the 1st and 2nd GARUBANO scanner, it is most desirable to be arranged as a design location in the pupil posion of the ftheta lens 25. However, since it is necessary to arrange the 1st and 2nd GARUBANO scanner so that each galvanomirror may not interfere mechanically, it has the trouble that it cannot but shift from a design location.

[0013] So, the technical problem of this invention is to offer the laser-beam-machining approach and processing equipment which do not need to receive location-constraint of optical system, especially a GARUBANO scanner as much as possible while being able to realize improvement in working speed.

[0014]

[Means for Solving the Problem] The laser-beam-machining approach by this invention divides the laser beam from a laser oscillation machine into the 1st polarization component and the 2nd polarization component by the 1st polarization beam splitter. Lead said 1st polarization component to the 1st GARUBANO scanner, and said 2nd polarization component is led to the 2nd GARUBANO scanner. The laser beam from said 1st GARUBANO scanner and said 2nd GARUBANO scanner, respectively It is characterized by irradiating two kinds of laser beams from superposition and this 2nd polarization beam splitter in the location where workpieces-ed differ through ftheta lens, respectively, and performing coincidence processing, as it introduces into the 2nd polarization beam splitter and is on a common optical path about two kinds of laser beams.

[0015] The 1st polarization beam splitter from which the laser-beam-machining equipment by this invention divides the laser beam from a laser oscillation machine and this laser oscillation machine into the 1st polarization component and the 2nd polarization component, The 1st GARUBANO scanner for making at least 1 shaft orientations shake so that the location of the request of said 1st polarization component on a workpiece-ed may be irradiated, The 2nd GARUBANO scanner for making at least 1 shaft orientations shake so that said 2nd polarization component may be irradiated at the position on said workpiece-ed, Said 2nd polarization beam splitter for piling up said 1st [the], said 1st [the] from the 2nd GARUBANO scanner, and the 2nd polarization component, as it is on a common optical path, and carrying out outgoing radiation of two kinds of laser beams, It is characterized by including ftheta lens for irradiating two kinds of laser beams from this 2nd polarization beam splitter at said workpiece-ed.

[0016] In addition, the said 1st and 2nd GARUBANO scanner makes 2 shaft orientations which intersect perpendicularly mutually, respectively shake the said 1st and 2nd polarization component.

[0017] Moreover, it is desirable that the 1st and 2nd mask for specifying the cross-section configuration of a laser beam to the outgoing radiation side of the said 1st [in said 1st polarization beam splitter] and 2nd polarization component, respectively is arranged.

[0018] Furthermore, the 1st and 2nd optical means for changing the linearly polarized light into the outgoing radiation side of said 2nd polarization beam splitter at the circular polarization of light, respectively may be arranged the incidence side of said 1st polarization beam splitter.

[0019] In the 1st concrete gestalt of the laser-beam-machining equipment by this

invention The 1st collimate lens for making said 1st polarization component from said 1st GARUBANO scanner project as a virtual image into said 2nd polarization beam splitter, It has further the 2nd collimate lens for making said 2nd polarization component from said 2nd GARUBANO scanner project as a virtual image into said 2nd polarization beam splitter, and the said 1st and 2nd GARUBANO scanner is arranged in the entrance pupil location of said ftheta lens, respectively.

[0020] In the 2nd concrete gestalt, the said 1st and 2nd GARUBANO scanner is arranged in the entrance pupil location of said ftheta lens, respectively.

[0021] In the 3rd concrete gestalt Between said 1st GARUBANO scanner and said 2nd polarization beam splitter, The 1st and 2nd collimate lens is arranged between said 2nd GARUBANO scanner and said 2nd polarization beam splitter, respectively. The laser beam from this 1st and 2nd collimate lens is always made to carry out incidence to said 2nd polarization beam splitter at a fixed include angle, respectively. A lens is arranged between said 2nd polarization beam splitter and said ftheta lens, and it is made for the laser beam from the said 1st and 2nd GARUBANO scanner to have a virtual image formed in it in the entrance pupil location of said ftheta lens.

[0022] Also in which the above-mentioned gestalt, the 3rd collimate lens may be arranged at the incidence side of said 1st GARUBANO scanner, and the 4th collimate lens may be arranged at the incidence side of said 2nd GARUBANO scanner.

[0023]

[Embodiment of the Invention] With reference to drawing 1 , the gestalt of operation of the 1st of the laser-beam-machining equipment by this invention is explained. In drawing 1 R> 1, this laser-beam-machining equipment has the laser oscillation machine 1 and the 1st polarization beam splitter 2 which divides the laser beam from the laser oscillation machine 1, the 1st polarization component, for example, a P wave polarization component, and the 2nd polarization component, for example, an S wave polarization component. As everyone knows, the 1st polarization beam splitter 2 makes a P wave polarization component penetrate, and has the property to reflect an S wave polarization component. The 1st GARUBANO scanner 4 for making this laser-beam-machining equipment shake again so that the location of the request of the 1st polarization component from the 1st polarization beam splitter 2 on a work piece 3 may be irradiated, The 2nd GARUBANO scanner 5 for making it shake so that the 2nd polarization component from the 1st polarization beam splitter 2 may be irradiated at the position on a work piece 3, The 1st collimate lens 7 for making the 1st polarization component from the 1st GARUBANO scanner 4 project as a virtual image into the 2nd polarization beam splitter 6, The 2nd collimate lens 8 for making the 2nd polarization component from the 2nd GARUBANO scanner 5 project as a virtual image into the 2nd polarization beam splitter 7, The 2nd polarization beam splitter 7 for carrying out outgoing radiation of superposition and the 1st and 2nd laser beam, as it is on a common optical path about the 1st [from the 1st and 2nd collimate lens 7 and 8], and 2nd polarization component, The ftheta lens 9 for irradiating two kinds of laser beams from the 2nd polarization beam splitter 6 at a work piece 3 is included.

[0024] Usually, although the location of said request with the 1st GARUBANO scanner 4 and the location of said request with the 2nd GARUBANO scanner 5 are different locations, the same location may irradiate.

[0025] Here, in drawing 1 , although the 1st and 2nd GARUBANO scanner 4 and 5 is

symbolically shown by one galvanomirror, respectively, as drawing 8 explained, with this gestalt, the so-called X-Y GARUBANO scanner at which 2 of X shaft orientations which intersect perpendicularly mutually, and Y shaft orientations shaft orientations can be made to shake an incidence laser beam is used. However, when the 1st and 2nd GARUBANO scanner 4 and 5 is equipped only with one galvanomirror, respectively depending on the case, the thing at which only 1 shaft orientations are made to shake an incidence laser beam may be used.

[0026] The 1st and 2nd mask 11 and 12 for specifying the cross-section configuration of a laser beam to the outgoing radiation side of the 1st [in the 1st polarization beam splitter 2] and 2nd polarization component, respectively is arranged. The 1st and 2nd mask 11 and 12 usually has a circular passage hole, respectively, and the circumference part in a cross-section configuration, i.e., a part with low energy intensity, is cut, and it is made for the energy density distribution in a cross-section configuration to become homogeneity.

[0027] Moreover, the 3rd collimate lens 13 is arranged at the incidence side of the 1st GARUBANO scanner 4, and the 4th collimate lens 14 is arranged at the incidence side of the 2nd GARUBANO scanner 5. The 3rd and 4th collimate lens 13 and 14 is for controlling that it is going to expand the beam diameter of the laser beam which carries out incidence.

[0028] Furthermore, the 1st lambda (1/4) plate 15 is arranged at the incidence side of the 1st polarization beam splitter 2, and the 2nd lambda (1/4) plate 16 is arranged at the outgoing radiation side of the 2nd polarization beam splitter 6. The laser beam from the laser oscillation machine 1 is the linearly polarized light with an S wave polarization component and a P wave polarization component, and the 1st lambda (1/4) plate 15 is for changing this linearly polarized light into the circular polarization of light, and is also called a phase plate. That is, it is for making it the energy density of the 1st and 2nd polarization component by which changes the linearly polarized light into the circular polarization of light, or changes the circular polarization of light into the linearly polarized light, and the spectrum was carried out in the 1st polarization beam splitter 2 set to 1:1 by giving phase contrast between an S wave polarization component and a P wave polarization component. In addition, the 1st and 2nd polarization component by which outgoing radiation is carried out serves as the linearly polarized light from the 1st polarization beam splitter 2. On the other hand, the 2nd lambda (1/4) plate 16 is for changing the linearly polarized light from the 2nd polarization beam splitter 6 into the circular polarization of light. In addition, the work piece 3 is carried on X-Y stage 17.

[0029] In the configuration of drawing 1 , after the laser beam from the laser oscillation machine 1 carries out incidence of drawing 2 to the 1st lambda (1/4) plate 15, it shows the polarization gestalt until a work piece 3 irradiates via the 2nd lambda (1/4) plate 16. Among drawing 2 , it is circular and the component which the shown component showed the P wave polarization component, and was shown in a straight line shows the S wave polarization component.

[0030] In this gestalt, two kinds of laser beams which carried out incidence to the 2nd polarization beam splitter 6 using the 1st and 2nd collimate lens 7 and 8 especially connect a virtual image in the 2nd polarization beam splitter 6 Nakauchi, and it has the description at the point currently compounded so that the laser beam from the 1st and 2nd GARUBANO scanner 4 and 5 may not interfere mutually. And the 1st and 2nd GARUBANO scanner 4 and 5 is arranged to the pupil posion of the ftheta lens 9,

respectively, and by letting the ftheta lens 9 pass, after making two kinds of laser beams from the 2nd polarization beam splitter 6 into the circular polarization of light, two kinds of laser beams are irradiated so that a focus may be connected on a work piece 3. And punching processing can be performed to coincidence by two kinds of laser beams as opposed to a work piece 3. If it says strictly, incidence of the laser beam from the 1st GARUBANO scanner 4 will be carried out to the field on the left-hand side of [in drawing 1] the ftheta lens 9, and incidence of the laser beam from the 2nd GARUBANO scanner 5 will be carried out to the field by the side of drawing 1 Nakamigi of the ftheta lens 9.

[0031] even if the pattern (arrangement pattern of the formed hole) of punching is completely the same, they may differ. That is, punching of a pattern which is different when punching of the same pattern will be performed if control to the 1st and 2nd GARUBANO scanner 4 and 5 is made the same, and it was made to perform different control will be performed. Moreover, although the number of work pieces 3 is one in drawing 1 , it may be made to perform punching of the same pattern, or different punching of a pattern to two work pieces.

[0032] As mentioned above, dichotomize by the 1st polarization beam splitter 2, and incidence of the laser beam from the laser oscillation machine 1 is carried out to the 1st and 2nd GARUBANO scanner 4 and 5. By making the laser beam from the 1st and 2nd GARUBANO scanner 4 and 5 project on the 2nd polarization beam splitter 6 as a virtual image with the 1st and 2nd collimate lens 7 and 8 These can be arranged to the pupil posion of the ftheta lens 9, avoiding mechanical interference of the 1st and 2nd GARUBANO scanner 4 and 5.

[0033] Drawing 3 shows the process which the laser beam of the 1st polarization component by the linearly polarized light from the 1st polarization beam splitter 2, i.e., P polarization component, is further changed into the circular polarization of light with the 2nd lambda (1/4) plate 16, and carries out incidence to the ftheta lens 9 via the 2nd polarization beam splitter 6.

[0034] Moreover, drawing 4 and drawing 5 show the case where a part of S polarization component irradiated by the work piece 3 is reflected there, and it returns in a reverse path. That is, the optical path which S polarization component by the circular polarization of light reflected at the work piece 3 is changed into the linearly polarized light with the 2nd lambda (1/4) plate 16, is reflected by the 2nd polarization beam splitter 6, and returns to the 1st polarization beam splitter 2 via each galvanomirror of the 2nd GARUBANO scanner 5 may be formed. However, with this gestalt, since there is the 2nd mask 12, such a return light is cut with the 2nd mask 12. The return light from a work piece 3 reaches the laser oscillation machine 1, and seems therefore, not to do a bad influence. This is the same also with the gestalt of the 2nd and the 3rd operation mentioned later.

[0035] By the way, when the laser beam which carries out incidence there carries out incidence of the ftheta lens 9 in parallel with the medial axis, the laser beam by which outgoing radiation is carried out from the ftheta lens 9 has the inclination irradiated with a certain include angle to the horizontal plane of a work piece 3. And if a laser beam carries out incidence with a certain include angle to a work piece 3, the pattern of the laser beam irradiated will deform into an ellipse form rather than will be circular. This means that the configuration of the hole formed in a work piece 3 becomes an ellipse form instead of a perfect circle. However, in this gestalt, two laser beams from the 2nd

polarization beam splitter 6 are not parallel to the medial axis of the ftheta lens 9 respectively, and incidence is aslant carried out. Thus, outgoing radiation of the laser beam which carried out incidence aslant is carried out so that it may become parallel to the medial axis with the ftheta lens 9. This can perform punching near a perfect circle to a work piece 3.

[0036] With reference to drawing 6 , the gestalt of operation of the 2nd of this invention is explained. Also in this gestalt, the 1st and 2nd GARUBANO scanner 4 and 5 is arranged in the entrance pupil location of the ftheta lens 9, respectively. The difference from the 1st gestalt of drawing 1 is in the point that the 1st and 2nd collimate lens 7 and 8 is omitted. Although other elements are the same as the 1st gestalt, if compared with the 1st gestalt in operation, interference may be generated among two kinds of laser beams.

[0037] With reference to drawing 7 , the gestalt of operation of the 3rd of this invention is explained. Although the component is almost the same as the gestalt of the 1st operation shown in drawing 1 , the laser beam from the 1st and 2nd collimate lens 7 and 8 is always made to carry out incidence of this gestalt to the 2nd polarization beam splitter 6 at a fixed include angle, respectively. Furthermore, he arranges a lens 18 between the 2nd lambda (1/4) plate 16 and the ftheta lens 9, and is trying for the laser beam from the 1st and 2nd GARUBANO scanner 4 and 5 to form a virtual image in it in the entrance pupil location of the ftheta lens 9. Since according to such a gestalt incidence is carried out by whenever [always same incident angle] even if the laser beam from the 1st and 2nd GARUBANO scanner 4 and 5 is shaken at the 2nd polarization beam splitter 6 how, in the point which change of permeability etc. does not produce, the twist is also excellent in the gestalt of the 1st operation.

[0038] In addition, especially the type of the laser oscillation machine used in this invention is CO2, for example, although not restricted. A laser oscillation machine, an YAG laser oscillator or its 2nd and 3rd higher harmonic, a YLF laser oscillation machine, or its 2nd and 3rd higher harmonic is suitable. Moreover, a resin layer, a ceramic substrate, etc. in a printed-circuit board are raised, and the work piece it becomes symmetrical processing does not restrict processing to punching processing, either.

[0039]

[Effect of the Invention] As explained above, according to this invention, improvement in working speed can be aimed at by carrying out incidence of two kinds of laser beams to one ftheta lens, and performing coincidence processing, and the laser-beam-machining equipment which does not need to receive location-constraint of optical-system elements, such as a GARUBANO scanner, as much as possible can be offered by moreover having arranged the polarization beam splitter to the incidence side of ftheta lens.